Yale Institute for Nanoscience and Quantum Engineering

Friday- October 19, 2012

12:00 to 1:00 p.m.

Becton Seminar Room

Light lunch will be served at 11:45 a.m.

Weihua Guan

Department of Electrical Engineering, Yale University

"Gated Ion Transport in Solid-State Nanochannels"

Nanochannels are channels with at least one dimension in the nanoscale, ranging from 1 to 100 nm. The nanometer scale of the structure allows the discovery of a new range of phenomena that has not been possible in traditional microchannels. Over the last few years, a lot attention has been paid to utilize the synthetic artificial nanochannels (nanopores) as tools for ultrasensitive biosensors, for regulating and separating ions and molecules in electrolyte solutions, and for energy harvesting. Inspired by the electric-field controlled electron/hole transport in MOSFETs, cation/anion transport through a nanochannel can be regulated in a similar fashion, which may lead to various interesting phenomena and applications. Here I will present the principles, fabrication techniques, and potential applications of the voltage gated ion transport in a solid-state nanochannel, driven by either (1) a potential gradient or (2) a concentration gradient.

Andrew Mack

Yale University School of Arts and Science, Applied Physics

"Kinetics and Thermodynamics of Nucleosome Winding and Unwinding"

Abstract: DNA is stored inside the cell nucleus at densities approaching crystal packing. Densely packaged DNA—and the genes for which they code—cannot be accessed by the cellular machinery. This requires that DNA can be packaged and unpackaged (turned on and off) during the cell life cycle. The fundamental structure of DNA packaging is the nucleosome, a 10 nm protein "spool" wrapped 1.7 times by DNA. Modified and variant nucleosomes are thought to regulate packaging by "tuning" the strength of DNA binding and/or recruiting cellular machines. To truly understand the regulation of nucleosome packaging, it is essential to deconvolute the effects of other molecular machines from the effects of changes in binding strength. To study this system, we apply force to single molecules of DNA packaged by nucleosomes and measure the kinetics of transitions between nucleosome states of unwinding. Using nucleosomes with modifications leading to known differences in gene expression, we find that nucleosome variations affect the transition rates between states of nucleosome unwinding. From these rates, we are able to determine the free energy difference induced by a nucleosome variation, thus correlating gene expression with rates and binding free energy, giving mechanistic meaning to chromatin "loosening" as a change in DNA binding free energy.

HOST: Mark Reed